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ABSTRACT

This study investigated barriers to calculator use in elementary school classrooms. Teachers (n=348) and principals (n=30) in western New York State were surveyed in 1988 about their feelings and beliefs about calculator use. Analysis of the responses found that teachers and principals believed that calculators should be used in elementary classrooms; however, teachers appeared to harbor fears about the effects of the use of calculators on students' learning. Principals appeared to be less concerned about negative effects. Teachers and principals believed that inservice programs would be most helpful to them in learning to integrate calculators in the K-6 elementary mathematics curriculum and that calculators needed to be readily available for instruction in the classroom. (KR)

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**Elementary Teachers' and Principals'
Feelings and Beliefs about Calculator Use**

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Teachers' and principals' feelings and beliefs about calculator use were assessed to gain insights into possible barriers to calculator use in elementary mathematics. A questionnaire was anonymously completed by 348 teachers and 30 principals in Western New York State during the Spring and Summer, 1988. Analysis of the responses found that teachers and principals believe that calculators should be used in elementary mathematics. Teachers appear to be harboring fears about the effects of the use of calculators on students' learning; principals appear to be less concerned about negative effects. They feel little press locally or on a state level to use calculators; instead, they are seeking direction and support on how to integrate calculator use in elementary mathematics. Teachers and principals feel that inservice programs are needed. Recommendations were: providing ongoing inservice support for teachers, and getting calculators into the classrooms.

Mathematics educators have been recommending the incorporation of calculator use into elementary mathematics throughout the 1970's and 1980's (Hembree & Dessart, 1986; Williams, 1987), reflecting society's shift from paper and pencil calculation to the dominant use of electronic processing in the workplace and in every aspect of life (Howson & Kahane, 1986; Steen, 1987). Yet calculators remain in limited use in elementary schools (Educational Testing Service, 1988; Hembree & Dessart, 1986). Several reasons have been put forward as factors inhibiting their use. The arrival of the microcomputer, for example, focused vast amounts of resources into microcomputer equipment with the hopes of revitalizing and enhancing mathematics instruction (Howson & Wilson, 1986; Preston, 1987; Reys & Reys, 1987; Williams, 1987). The 1970's "back-to-the-basics" movement in education stressed a textbook approach with an emphasis on paper and pencil calculation; the calculator was not seen as a central, or even peripheral, element in the improvement of mathematics performance (Howson & Kahane, 1986).

Mathematics educators continue to advocate the use of calculators in elementary mathematics. The National Council of Teachers of Mathematics restated their 1974 and 1986 position urging the use of calculators as an integral part of mathematics programs in Curriculum and Evaluation Standards for School Mathematics (Working Groups of the Commission on Standards for School Mathematics of the National Council of Teachers of Mathematics, 1989). The Association of Mathematics Teachers of New York State's position statement supported the National Council of Teachers of Mathematics' position

regarding calculator use and also recommended that some state-wide mathematics exams be revamped to permit limited use of calculators (Association of Mathematics Teachers of New York State's Ad Hoc Committee on Calculators in the Mathematics Classroom, 1988). The National Academy of Science report, Everybody Counts: A Report to the Nation on the Future of Mathematics Education, recommended greater calculator use in elementary schools as a way of helping students keep pace with a "mathematics revolution" that favored the logic of problem solving over purely computational skills (Rothman, 1989). The National Assessment of Educational Progress report (Educational Testing Service, 1988) advised continued efforts be made to help students explore a broader range of mathematical concepts and skills by instructing them in the use of calculators. The report says:

Despite the advent of new technologies (calculators and computers), there appears to have been little movement in the mathematics curriculum away from the past reliance on teacher and textbook. The calculator holds great promise in helping students to compute, yet its availability and usage in the mathematics classrooms is surprisingly limited. (p. 91)

Why is it that mathematics educators have been espousing calculator use, but so little impact has occurred at the school level? This problem was the central focus of the study.

One uninvestigated reason for this problem is that at the school level teachers and principals do not share the same feelings and beliefs about the benefits of calculator use as do mathematics educators. Perhaps this predicament was another factor inhibiting the utilization of calculators during the 1970's and 1980's.

Teachers' and principals' feelings and beliefs have an effect on educational change. Research during the past decade found that teachers' feelings and beliefs have a profound effect on their teaching and on student learning (Peterson, Fennema, Carpenter, & Loef, 1987). Teachers' beliefs, thoughts, judgments, and knowledge about an innovation influence the degree to which an innovation is valued and the extent to which it is implemented in schools (Howson & Wilson, 1986; Peterson, Fennema, Carpenter, & Loef, 1987; Waugh & Punch, 1987). Effective schools research found that a principal's active support of innovation and school change is important in determining whether an innovation is continued or whether it withers away (Behling & Champion, 1984). If an innovation is to be adopted, principals must show commitment to it (De Bevoise, 1984).

It seemed that a systematic inquiry of practitioners' feelings and beliefs would provide insights and help identify barriers that may be hindering calculator use in schools. The research questions central to that inquiry were:

1. What are teachers' feelings and beliefs about the effects of calculator use in elementary mathematics?
2. What are principals' feelings and beliefs about the effects of calculator use in elementary mathematics?
3. Do teachers and principals have similar feelings and beliefs about the effects of calculator use in elementary mathematics?

4. What do teachers and principals believe would be of most help in facilitating the integration of calculators in the K-6 elementary mathematics curriculum?
5. What do teachers and principals believe has most hindered the use of calculators in the elementary mathematics program?

Given insights into teachers' and principals' feelings and beliefs, barriers can be identified and strategies formulated to surmount them; then, more efficient and effective measures can be taken to implement recommendations and incorporate calculator use into elementary mathematics (Howson & Wilson, 1988; Research Advisory Committee of the National Council Teachers of Mathematics, 1988).

Method

A two part questionnaire was developed as an assessment instrument; a review of the literature did not find one suitable to assess teachers' and principals' feelings and beliefs about calculator use. In the first part of the questionnaire, respondents were asked personal and professional factors: educational position [1987-88 school year], gender, location of district, length of experience in education, length of teaching experience, grade level teaching experience, calculator inservice/workshop experience, college course experiences with calculators, and calculator availability. The first part included open-ended questions concerning what would be most helpful integrating calculators in the mathematics curriculum, what has most hindered the use of calculators, and how calculators were available and use in schools. In the second part, practitioners were

asked to respond to 31 statements from the point of view of their position during the 1987-1988 school year. A six point Likert-type scale [1--strongly agree, 2--agree, 3--slightly agree, 4--slightly disagree, 5--disagree, and 6--strongly disagree] was used to encourage thoughtful responses to statements, rather than "undecided."

Statement and open-ended questions responses are presented in this paper. Additional research questions which queried the effect of teachers' and principals' personal and professional factors on their statement responses, and asked further information about calculator availability and usage in schools, can be found in the dissertation study (Terranova, 1989)

Several steps were taken to insure the quality of the statements and the questionnaire (Miles & Huberman, 1984; Parten, 1950; Sudman & Bradburn, 1985). The statements were based on information from research, a preliminary survey, and discussions with educators. They were reviewed twice: first, by four doctoral students to determine ambiguous statements, and again, after revision, by seven experts in the field of mathematics education to determine the statement's importance. The final selection of statements centered on the recommendations made by experts in the field of mathematics education, thus providing face validity of the instrument.

The final form of the questionnaire was cooperatively written and review with attention given to techniques and suggestions that strengthen the questionnaire design (Kerlinger, 1986; Miles & Huberman 1984; Parten, 1950; Presser & Converse, 1986; Sudman & Bradburn, 1985). In developing the final assessment instrument,

the following techniques were used: (1) randomly arranging statements with care that the first statement was easy to respond to, (2) embedding a lie factor statement to ascertain the respondent's attention to reading statements for understanding, and (3) adding open-ended responses to gather subjective opinions.

Additionally, two pairs of statements were worded to give opposite responses to the same concept: items [#4 & #21] and [#7 & #19]. Moderate negative correlations [$r = -.522$ and $r = -.538$] provided evidence of response reliability in the instrument. A pilot study conducted in a school district in Western New York State gave no indication that the questionnaire needed revision.

A sample of Western New York State teachers and principals anonymously completed the questionnaire during the Spring and Summer, 1988. The samples were made gathered as follows: 348 teachers in K-6 from participating school districts (201), graduate classes (100), and a teacher center's inservice programs (47); 30 elementary principals from participating school districts (15), graduate classes (1), and a randomly selected mailing (14).

Attention was given to the representativeness of the samples. Information from the publication, Public School Professional Personnel Report, New York State: 1987-1988 confirmed that the samples were representative of New York State teachers and principals. Information such as location and type of school district reported on the first part of the questionnaire, verified the representativeness of the samples within the Western New York State region.

The sampling was evaluated using Sudman's credibility scale for judging small samples. The following factors were assigned arbitrary weights: generalizability, size, execution, and use of available resources (Sudman, 1983). A score was determined which differentiated each sample between the best [high score] and worst [low score] of sample designs. Both samples rated highly.

The distribution of questionnaires was managed by individuals within the school district or site as best suited their internal policies and procedures. A cover letter accompanied the questionnaires, explaining the purpose of the survey and providing general directions for administering the questionnaire. A reasonable estimate of the response rate, based on total of questionnaires distributed and returned was 42%. The response rate to the randomly selected principal mailing was 33%; a follow-up mailing was not done because of time and expense.

Responses to the open-ended questions were categorized based on their common elements and percentages were calculated. After percentages of Likert-type responses were calculated for the statements, the responses were: displayed graphically, operational language descriptors were defined, and summary tables were made describing and comparing teachers' and principals' responses. Following is a description of the arbitrary operational language descriptors, used in presenting the summary table responses.

The bargraphs constructed for each statement, displayed the percentages of teachers' (T) and principals' (P) Likert-type responses on the six-point scale. A boldfaced line separated the cumulative

"agree" responses (choice of 1,2,3 positions on the scale) from the cumulative "disagree" responses (choice of 4,5,6 positions on the scale). The bargraphs in Figure 1 reflect responses to statements 3, 4, 6, 15, 22, 23, 28, and 31 on the questionnaire. Figure 1 provides a set of illustrative bargraphs from which the arbitrary meanings of the descriptors in Table 1 and Table 2 were derived. Operational language descriptors were developed from these bargraphs to allow for a succinct presentation of results in tabled format.

Insert Figure 1 about here

Insert Table 1 about here

Insert Table 2 about here

Results and Discussion

Responses associated with the effects of calculator use on student learning, on curriculum and instruction, and the effects of outside presses on calculator use are displayed on Table 3, Table 4, and Table 5.

Insert Table 3 about here

Principals, and especially teachers, appeared to be unsure about the effects of calculator use associated with student learning; and, their comparative responses to most statements differed (see Table 3). In some cases, responses were inconsistent with empirical research

results. For example, both teachers and principals responded neutrally to the statement that using calculators helps students learn, retain, and internalize number facts. Yet research evidence has indicated that calculator use helps students with these skills. Teachers and principals tended to differ in their feelings and beliefs, either in orientation or degree, in the majority of statements regarding student learning.

These responses suggest that teachers, and principals to a lesser degree, tend to harbor fears about the effects of calculator use on student learning. Research based information about the positive effects of calculator use on students' achievement needs to be shared in meaningful ways. In addition, encouraging practitioners to carry-out "action" research projects, would not only help them satisfy their concerns, but also contribute to our body of knowledge about calculator use in school programs. Articulation between the research community at college/university level and practitioners at the school level would facilitate type of cooperative research.

Teachers and principals were in agreement to the same degree in their feelings and beliefs associated with several items in the curriculum and instruction subgroup of statements (see Table 4). They agreed that there is a need to know how to incorporate calculator use in the mathematics program, that instructional strategies need to be introduced and developed with students at every level, and that more mathematics content will be teachable through student exploration when calculators are used.

Insert Table 4 about here

It seems that teachers and principals believe that students should be using calculators but are unsure of "what to do" and "how to do" whatever it is they "should" be doing. A reason for their beliefs may stem from a notion that many elementary practitioners have that paper-pencil arithmetic calculation is mathematics; since mathematics is not the "strong" subject area of most elementary teachers and principals, the thoughts of removing a great portion of what teachers feel they are capable of teaching well (paper-pencil calculation), and what principals feel teachers need to teach (its tested), promotes anxiety and resistance to change.

It appears that teachers need an understanding of the shift or redirection of emphasis that will take place in elementary mathematics as calculators become an integral tool of elementary mathematics. The time they once spent developing students' speed and proficiency in paper-pencil computational skills will now be spent developing students' mathematical concepts, understandings, and application through problem solving. Their neutral response to statement 11 suggests that the shift or redirection in "time" from computational skills to higher thinking skills is not understood.

Teachers' and principals' responses to statements associated with curriculum and instruction suggest they perceive a need for students to use calculators. However, teachers' needs appear in opposition to student needs; teachers feel that they need to know "what to do" with calculators and "how to do" it. This is compounded by their feeling

that the curriculum is already too big to "add on" another thing to do. The principals' perceived student need may be strongly influenced by the testing programs used to evaluate student performance.

Since testing relates to two broad subgroups of statements--curriculum and instruction and outside pressures--it will bridge the discussion between these two topics. Principals have an additional burden with regards to curriculum and instruction; that is, an accountability for the standardized test scores of students in their schools. Testings' influence on principals' beliefs about the value of paper-pencil computing techniques, perhaps accounts for their seemingly inconsistent responses to items regarding the objectives of curriculum and instruction. They felt that while estimation and mental calculation were increasingly important skills to be taught, students still needed to know paper-pencil computing techniques; they only mildly agreed that paper-pencil computing techniques that promote understanding should have precedent over techniques that are "speedy" and efficient. The inconsistency lies in the fact that speed and efficiency are used to demonstrate calculating proficiency rather than to demonstrate understanding of mathematical concepts on tests.

What might cause principals to have inconsistent beliefs? Principals are held accountable to boards of education and to the community for students' test results; a principal's merit to a district is often tied to what happens on the testing profile for his or her building. Some tests still require proficiency in calculation skills,

thereby placing limits on what is taught and how it is taught in elementary mathematics to those things that are tested.

Did teachers and principals feel outside of school pressures to using calculators in elementary mathematics? Their responses on Table 5 suggest that they did not feel additional outside pressures to use calculators, but instead, were looking for direction and support.

Insert Table 5 about here

Although types of support varied from providing calculators, to developing district policy statements and guidelines for calculator use, to developing inservice programs to support calculator use, they have a common element; they demonstrate commitment by the building, district, and state to incorporation of calculators into elementary mathematics. This commitment from various levels within the educational system has been identified as necessary component of successful educational change (Waugh & Punch, 1987).

Responses suggest that the involvement of parents, teachers, and other members of the school community from other levels would be helpful to the integration process; another necessary component of successful educational change (Waugh & Punch, 1987). Existing forums to meet with the school community, such as Parent Teacher Student Association meetings, informational grade level meetings, district workshop days could be used to share information and address concerns.

The similarity between teachers' and principals' feelings and beliefs was not consistent; they significantly disagreed (operational language

comparison responses 3 and 5) to about one-fourth of the statements. Most differences were associated with the effects of calculator use on student learning. Principals' responses to these items suggested more positive feelings and beliefs than did teachers' responses. The difference in response to the statements regarding time in the curriculum and the influence of publishers regarding textbooks, suggested that teachers' and principals' beliefs about two major influences on "what is taught" and "how it is taught" were seen differently.

The practitioners' views of forces hindering calculator use in schools, and those forces potentially helpful to integrating calculators in elementary mathematics are presented Figure 3 and Figure 4. Both teachers and principals felt that fear was a barrier to calculator use (see Figure 3). Their fears encompassed ideas that calculators would become a crutch, replacing students' mathematical thinking, reasoning, and mental computational abilities, and that students would not learn basic skills.

Insert Figure 3 about here

Some typical responses give the flavor of the caring but unfounded fears harbored by practitioners. A principal said, "I fear, and I think a not unreal fear, that students will not master computational strategies on their own but instead will use the calculator as 'a crutch.'" An experienced teacher replied, "Children will rely on calculators rather than their own thought processes to learn math concepts." Although associated with a concern for students' well-being, the expressed fears

suggest that a lack of understanding of mathematics and the aims of mathematics as a part of the elementary curriculum, exists. What can be done to help teachers and principals conquer their fears?

Perhaps the reply to that query is the same reply given most frequently by teachers and principals in response to the open-ended question which asked, "What ... would be most helpful in facilitating the integration of calculators in the K-6 elementary mathematics curriculum?" Their reply was inservice programs (see Figure 4).

Insert Figure 4 about here

Inservice programs would provide forums for teachers and principals to increase their mathematical experiences. For teachers, an increase in knowledge based on experience would expand their mathematical thinking, providing them with new ideas to building students' mathematical experiences. For principals, an increase in knowledge based on experience would assist them in providing effective instructional leadership in the area of elementary mathematics.

Calculators need to be readily available for use in the classroom. The difference between teachers' and principals' views about calculator availability suggests that the availability of calculators is an impediment for teachers who may feel more confident in using calculators in elementary mathematics.

Summary

Both teachers and principals believe that calculators should be used in elementary mathematics. Teachers appear to be harboring fears about the effects of the use of calculators on students' learning; principals appear to be less concerned about negative effects. Teachers and principals feel little press locally or on a state level to use calculators; instead, they are seeking direction and support their use.

Teachers and principals believe that inservice programs would be most helpful to them in learning to integrate calculators in the K-6 elementary mathematics curriculum. Inservice programs would provide forums to (1) address fears and concerns, (2) provide an experience base with calculators as tool of instruction, and (3) provide experiences with mathematics.

Additionally, inservice programs can be designed to provide **ongoing support** for teachers throughout the process of integration and incorporation of calculator use. This type of support appears to be the bridge needed for teachers to replace their apprehensions with experiences that enable them to integrate calculator use into elementary mathematics. And, calculators need to be made readily available for instruction in the classroom.

REFERENCES

- Association of Mathematics Teachers' of New York State's Ad Hoc Committee on Calculators in the Mathematics Classroom. (1988). Calculators in mathematics classes: AMTNYS Position Statement. New York State Mathematics Teachers' Journal, 38(1).
- Behling, H. E., & Champion R. H. (1984). The principal as an instructional leader. Lutherville, MD: Instructional Improvement Company.
- Converse, J. M., & Presser, S. (1986). Survey questions: Handcrafting the standardized questionnaire. CA: Sage.
- De Bevoise, W. (1984). Synthesis of research on the principal as instructional leader. Educational Leadership, 41, 14-20.
- Educational Testing Service. (1988). The mathematics report card: Are we measuring up? Trends and achievements based on the 1988 national assessment. Princeton, NJ: Author.
- Hembree, R., & Dessert, D. J. (1986). Effects of hand-held calculators in precollege mathematics education: A meta-analysis. Journal for Research in Mathematics Education, 17, 83-99.
- Howson, G., & Wilson, B. (1986). School mathematics in the 1990's. Cambridge: University Press.
- Kerlinger, F. N. (1986). Foundations of behavioral research (3rd ed.). NY: Holt, Rinehart and Winston.
- Miles, M. B., & Huberman, A. M. (1984). Qualitative data analysis: A sourcebook of new methods. CA: Sage.

- New York State Education Department. (1988). Public school professional personnel report: New York State: 1987-1988. Albany, NY: Author.
- Parten, M. (1950). Surveys, polls, and samples: Practical procedures. New York: Harper & Brothers.
- Peterson, P. L., Fennema, E., Carpenter, T. P., & Loef, M. (1987). Teachers' pedagogical content beliefs in mathematics (Report No. MDR-8550236). Washington, DC: National Science Foundation.
- Preston, M. (1987). Mathematics in primary education. England: Falmer Press.
- Research Advisory Committee of the National Council of Teachers of Mathematics. (1988). NCTM curriculum and evaluation standards for school mathematics: Responses from the research community. Journal for Research in Mathematics Education, 19, 338-344.
- Reys, B. J., & Reys, R. E. (1987). Calculators in the classroom: How can we make it happen? Arithmetic Teacher, 34, 12-14.
- Rothman, R. (1989, February 1). Academy urges nation To 'Wake Up' and revamp mathematics education. Education Week, pp. 5.
- Steen, L. A. (1987, October 14). Point of view: Who still does math with paper and pencil? The Chronicle of Higher Education, p. A48.
- Sudman, S., & Bradburn, N. M. (1982). Asking questions: A practical guide to questionnaire design. CA: Jossey-Bass Inc.
- Sudman, S. (1983). Applied sampling. In P. H. Rossi, J. D. Wright, & A. B. Anderson (Eds.), Handbook of survey research (pp. 145-194). NY: Academic Press.

- Terranova, M. E. S. (1989). A study of teachers' and principals' feelings and beliefs about calculator use in elementary mathematics (Doctoral dissertation, University at Buffalo, 1989).
- Waugh, R. F., & Punch, K. F. (1987). Teacher receptivity to systemwide change in the implementation stage. Review of Educational Research, 57, 237-254.
- Williams, D. E. (1987). A calculator-integrated curriculum: The time is now. Arithmetic Teacher, 34, 8-9.
- Working Groups of the Commission on Standards for School Mathematics of the National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: Author.

Table 1
Teacher (T) or Principal (P) Operational Language Descriptors

Symbol	Descriptor	Arbitrary meaning (Refer to Figure 1)
SD	Strongly disagree	Boldface dividing line was between 0 and 21 on percent scale (see "P", statement 28)
D	Disagree	Boldface dividing line was between 20 and 36 on percent scale (see "T", statement 31)
MD	Mildly disagree	Boldface dividing line was between 35 and 46 on percent scale (see "P", statement 4)
N	Neutral	Boldface dividing line was between 45 and 56 on percent scale (see "T" or "P", statement 15)
MA	Mildly agree	Boldface dividing line was between 55 and 66 on percent scale (see "T", statement 4)
A	Agree	Boldface dividing line was between 65 and 81 on percent scale (see "T", statement 22)
SA	Strongly agree	Boldface dividing line was between 80 and 100 on percent scale (see "T", statement 6)

Table 2
Comparative (C) Operational Language Descriptors

Symbol	Descriptor	Arbitrary meaning (Refer to Figure 1)
1	same orientation, same degree	Both (T and P) had same agree-disagree orientation, and differed by 10% or less (see statements 6 and 31)
2	same orientation, differ to a slight degree	Both (T and P) had same agree-disagree orientation, but differed by 11 to 20% (see statements 3 and 23)
3	same orientation, differ to a significant degree	Both (T and P) had same agree-disagree orientation, but differed by greater than 20% (see statements 22 and 28)
4	different orientation, degree of difference is slight	(T and P) had different agree-disagree orientation, but differed by 10% or less (see statement 15)
5	different orientation, degree of difference is significant	(T and P) had different agree-disagree orientation, but differed by greater than 10% or less (see statement 4)

Table 3

*Teacher (T), Principal (P), and Comparative (C) Responses
Associated with Student Learning*

Statement	Response		
	T	P	C
Thinking & reasoning			
4. If used extensively in elementary programs, calculators will become a 'crutch' to students and negatively effect mathematics thinking ability.	MA	MD	5
7. Calculators are tools that (will) allow students to focus more attention on mathematics concept development and understanding.	A	SA	3
17. Students who use calculators in school mathematics programs (will) do not understand the basic operations as well as those not using calculators.	MD	MD	1
22. Calculator use (will) benefits student achievement in problem solving.	A	SA	3
Affective domain			
9. Students who use calculators (will) lose sight of the importance of mathematics.	D	SD	2
20. Using calculators (will) decrease(s) student motivation in mathematics class.	SD	SD	2
Skills			
15. Using calculators (will) help(s) students learn, retain, and internalize number facts.	N	N	4
28. Using calculators (will) cause(s) students to forget how to do paper-pencil calculations.	MD	SD	3
General cognitive domain			
19. I think calculators (will) confuse and inhibit K-6 students' learning of mathematics.	D	D	1
21. Students who use calculators (will) learn mathematics better than those who do not use them.	MD	MA	5
Equity effects			
31. Using calculators in the elementary mathematics program will contribute to learning inequities between students from wealthy and poor backgrounds.	D	SD	1

Table 4
Teacher (T), Principal (P), and Comparative (C) Responses
Associated with Curriculum & Instruction

Statement	Response		
	T	P	C
Methods			
1. Instructional strategies that use the calculator need to be introduced, developed, and encouraged at every level of the elementary school.	A	A	1
6. There is a need to know, and better understand, how to incorporate calculator use into the regular mathematics instructional program.	SA	SA	1
18. Calculators make more mathematics content teachable through the use of student explorations---trial-error, guess-test, etc.	A	SA	1
Objectives			
2. If calculators are used in school mathematics programs, students (will) no longer need to know paper-pencil computing techniques.	D	SD	2
13. Extensive use of calculators in elementary mathematics programs make estimation and mental calculations increasingly important skills to be taught.	A	SA	1
30. If calculators are used in school mathematics programs, paper-pencil computing techniques that promote understanding should have precedent over techniques that are 'speedy' and efficient.	A	MA	2
Time			
11. Lack of instructional time in the elementary mathematics program makes it difficult to introduce and use calculators.	N	D	5

Table 5
Teacher (T), Principal (P), and Comparative (C) Responses
Responses Associated with Outside Presses on Calculator Use

Statement	Response		
	T	P	C
Inservice			
3. In-service programs are needed to help teachers incorporate calculator use into classroom mathematics instruction.	SA	SA	2
Testing			
5. Local, state, and national testing programs are a significant factor inhibiting the widespread use of calculators in the elementary mathematics programs.	MA	MA	1
24. Calculators should not be used on any part of a school district's standardized test administration.	N	N	4
Administration			
8. State education department officials are not exerting any significant leadership in promoting calculator use in the elementary school program.	SA	SA	1
26. There is considerable "press" from central office administration staff to purchase and use calculators in the elementary mathematics program.	SD	SD	1
Teachers			
10. Most elementary teachers are too set in their ways to get extensively involved with using calculators at this point in their career.	MD	MD	1
12. There is considerable "press" from junior and senior high school mathematics teachers to use calculators in the elementary mathematics program.	D	SD	2
Upkeep			
14. Problems with distribution, upkeep, and security of calculators make them more trouble than they are worth at the elementary school level.	D	D	1
District support			
16. School districts should formulate a comprehensive policy statement on the use of calculators if they want calculators used at the school level.	SA	SA	1
Tradition/society			
23. Since the current adult generation successfully learned elementary mathematics without calculators, there is no need to introduce calculators to today's students.	SD	SD	2
Publisher			
27. If I were involved in choosing a mathematics textbook for use in my school building, the degree of calculator use would be a very important criterion.	MD	A	5
Parental support			
29. Given appropriate program information, parents of my students are (would be) generally supportive of calculator use in their children's classroom.	A	SA	1

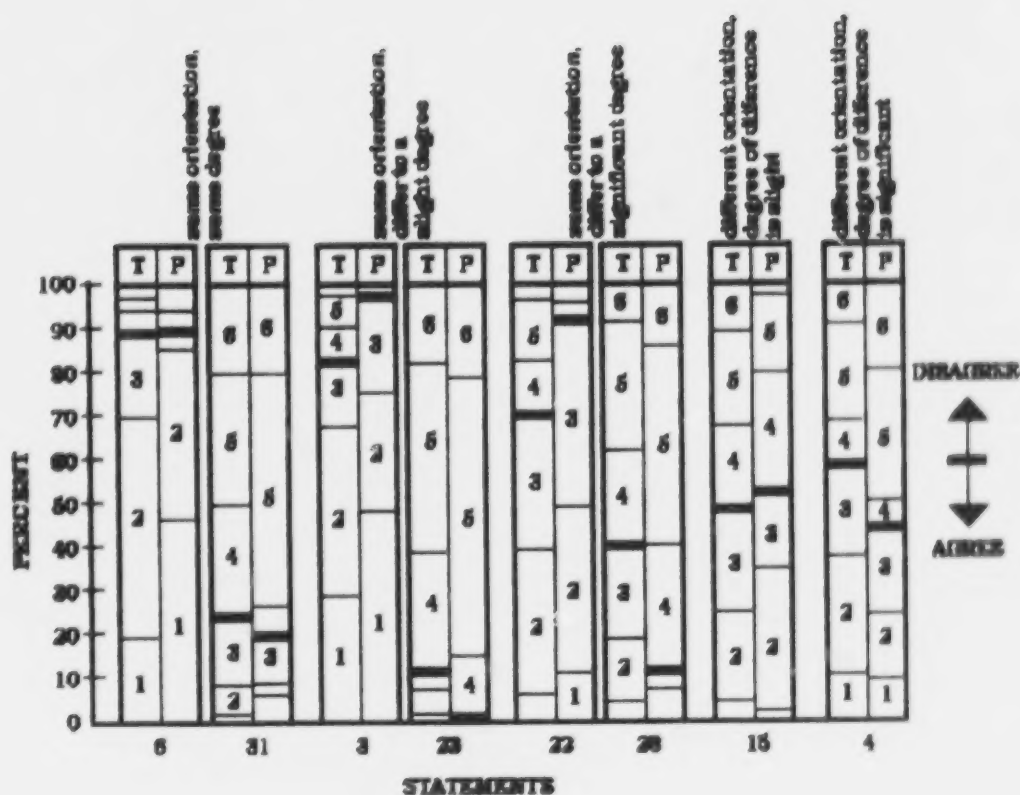


Figure 1. Bargraphs reflecting responses to questionnaire statements.

Figure 2. Comparative view of hindering forces.

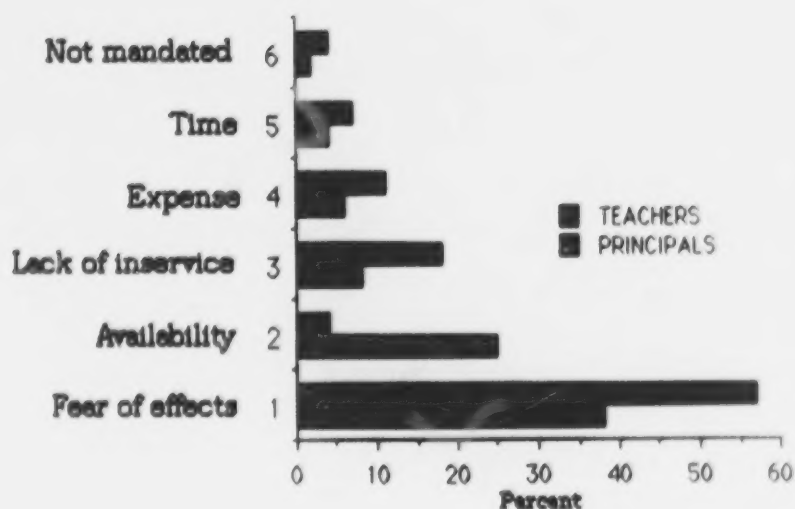


Figure 3. Comparative view of helping forces.

